DOCUMENT RESUME

ED 156 598 SO 011 006

AUTHOR Knight, Sarah S.; Johnson, Eugene G.
TITLE Relating Art Experiences to Art Achievement: A Technical Paper.
INSTITUTION Education Commission of the States, Denver, Colo. National Assessment of Educational Progress.
PUB DATE Jul 78
NOTE 19p.; Exhibits 1 and 2 may not reproduce clearly in hard copy due to small type size of original document

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Affective Tests; *Art Appreciation; *Art Education; Cognitive Tests; *Educational Assessment; Elementary Secondary Education; Evaluation Methods; Factor Analysis; *National Surveys; *Student Experience

ABSTRACT

This study examined the relationship of cognitive and affective objectives to art experiences using data from the 1974-75 national assessment of art. The 1974-75 assessment used art exercises to measure cognitive and affective objectives of nearly 27,000 students aged 9, 13, and 17. The cognitive exercises were designed to assess students' perceptions and responses to aspects of art, their knowledge perceptions and responses to aspects of art, their knowledge of specific artworks and artistic periods, and their ability to make and justify judgments about aesthetic merit and quality of works of art. Affective exercises were aimed at securing information about students' general affective orientation toward art, their ability to recognize and express reasonably sophisticated conceptions of artworks and artists, and their openness toward artistic experimentation and unusual forms and styles of artwork. Students were questioned about their experiences with art: art done outside of school; visits to art museums or galleries; collecting art; and learning art or taking art classes in school. Singular Value Decomposition and Principal-Component analyses were used. These results suggest positive relationships between art experiences and performance on knowledge and affective exercises. Findings showed that the more art experiences students have the greater percentage of correct or desirable responses to cognitive and affective exercises. (Author/BC)

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RELATING ART EXPERIENCES TO ART ACHIEVEMENT

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A Technical Paper

prepared by

Sarah S. Knight and Eugene G. Johnson

National Assessment of Educational Progress

July 1978

SP 011 006

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INTRODUCTION

The national assessment of art was the first comprehensive attempt to measure student achievement in art on a national scale at the elementary, junior high and high school levels. The art assessment involved nearly 27,000 students aged 9, 13 and 17 and was conducted during the 1974-75 school year.

The assessment included two large sets of art exercises: those used to measure cognitive, or knowledge, objectives and those used to measure attitudinal, or affective, objectives. The knowledge exercises were designed to assess students' perceptions and responses to aspects of art, their knowledge of specific artworks and artistic periods, and their ability to make and justify judgments about aesthetic merit and quality of works of art.

Affective exercises were aimed at securing information about students' general affective orientation toward art, their ability to recognize and express reasonably sophisticated conceptions of artworks and artists, and their openness toward artistic experimentation and unusual forms and styles of artwork.

In addition to the knowledge and affective exercises, a set of questions was included to gather information about students' experiences with art. These questions were used to define experience groups and categories, which were in turn used to classify students. The five general groups or kinds of art experiences defined for 13-year-olds and for 17-year-olds who were enrolled in school at the time of the assessment are shown in Table 1. The table includes a breakdown of art experiences into categories available for analysis and into those categories used in Singular Value Decomposition analyses described on pages 7 through 9 of this report.

An examination of art summary data for 13- and 17-year-olds with various kinds of art experiences, displayed in Exhibits 1 and 2, reveals interesting patterns of performances within experience groups across exercise sets. The exhibits suggest positive relationships between art experiences and performance on knowledge and affective exercises.

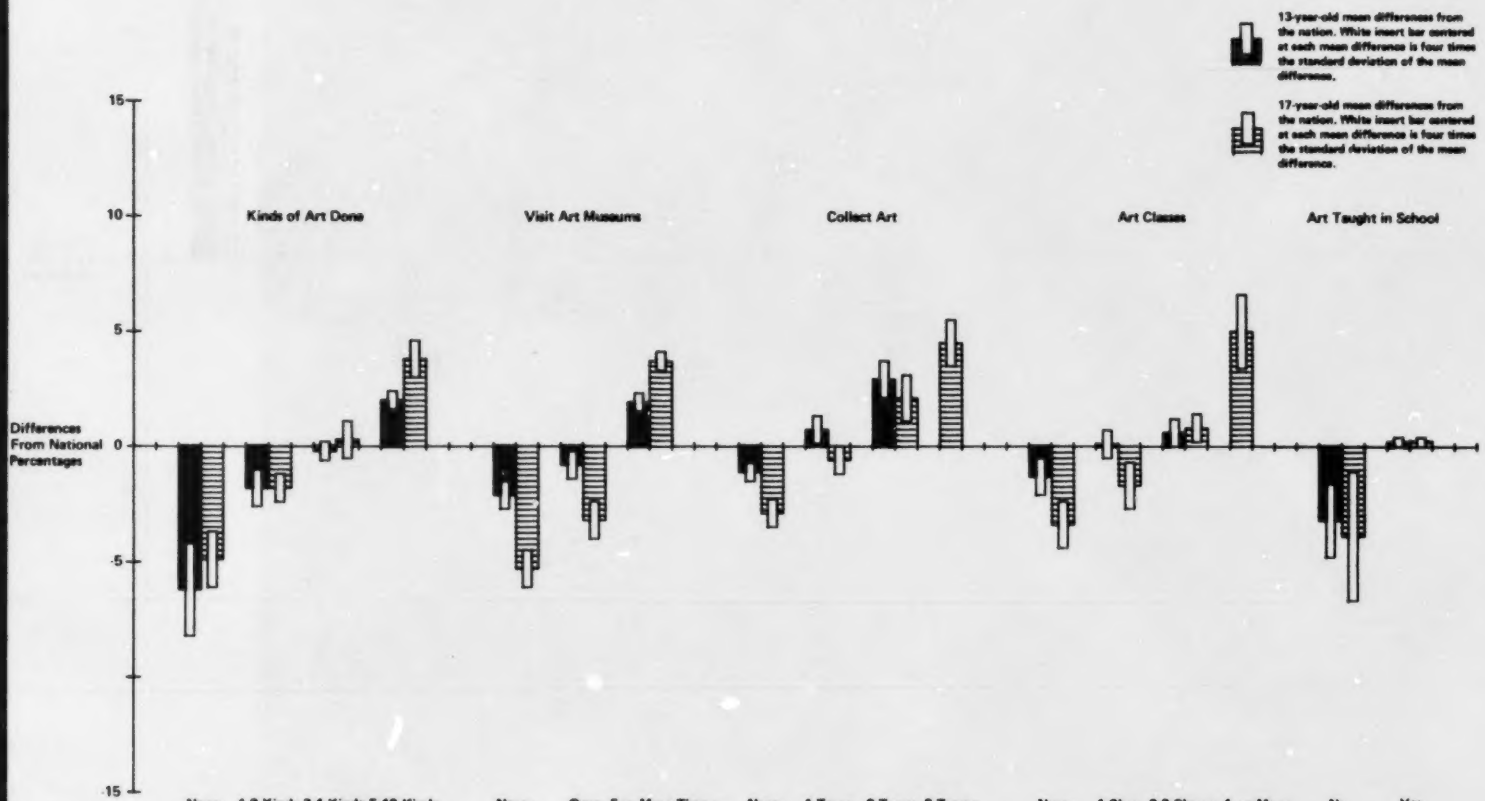
Exhibit 1 shows that performance level on knowledge exercises is highest by 13- and 17-year-olds who indicate 5 to 10 kinds of art done outside of school. Conversely, performance is lowest for those 13- and 17-year-olds who said they did no art outside of school. The same relationship between performance and experience -- that is, the more experience the greater the percentage of correct or desirable responses to knowledge or affective exercises -- occurs for visits to art museums, collecting art, taking art classes and attendance at a school where art is taught. Note that 17-year-olds who score higher than the national level on knowledge exercises have taken 4 to 6 art classes, whereas 13-year-olds probably have not had an opportunity to take as many classes. The

TABLE 1. Art Experience Groups

Type of Experience	Experience Categories From Assessment	Experience Categories for SVD* Analysis
1. Art done outside of school. Students were asked if they did certain kinds of artwork outside of school. Thirteen- and 17-year-olds were asked if they drew, painted, made collages, carved, made prints, made pottery, did weaving or needlework, made photographs, made jewelry or created designs for clothes, houses, etc.	a. No art done b. 1-2 kinds done c. 3-4 kinds done d. 5-10 kinds done	a. A combination of "no art done," 1-2 kinds done, 3-4 kinds done b. 5-10 kinds of art done
2. Visit art museums or galleries. All students were asked how often they visited art museums or art galleries.	a. Never b. 1 time c. 5 or more times	a. A combination of "never" and "1 time" b. 5 or more times
3. Collect art. Thirteen- and 17-year-olds were asked if they collected reproductions of artworks and/or originals. Seventeen-year-olds also were asked if they collected antiques.	a. No art collected (none) b. 1 type collected c. 2 types collected d. 3 types collected (17-year-olds only)	a. No art collected b. A combination of 1, 2 and 3 types of art collected
4. Learn art or art classes taken in school. Students were asked if they were enrolled currently in an art class. Thirteen-year-olds were asked if they had taken an art class during the previous school year. Seventeen-year-olds were asked if they had taken an art class in any grade from the seventh through their present grade.	a. No classes taken b. 1 class taken c. 2 classes taken (13-year-olds) or 2-3 classes (17-year-olds) d. 4 or more classes taken (17-year-olds only)	a. A combination of "no classes" and "1 class taken" b. A combination of "2 to 3 classes" and "4 or more" for 17-year-olds, "2 classes taken" for 13-year-olds
5. Art taught. Principals of schools participating in the art assessment were asked if art was taught in their school.	a. Yes b. No (including those who completely failed to respond to the question and those who said "I don't know")	a. Yes b. No

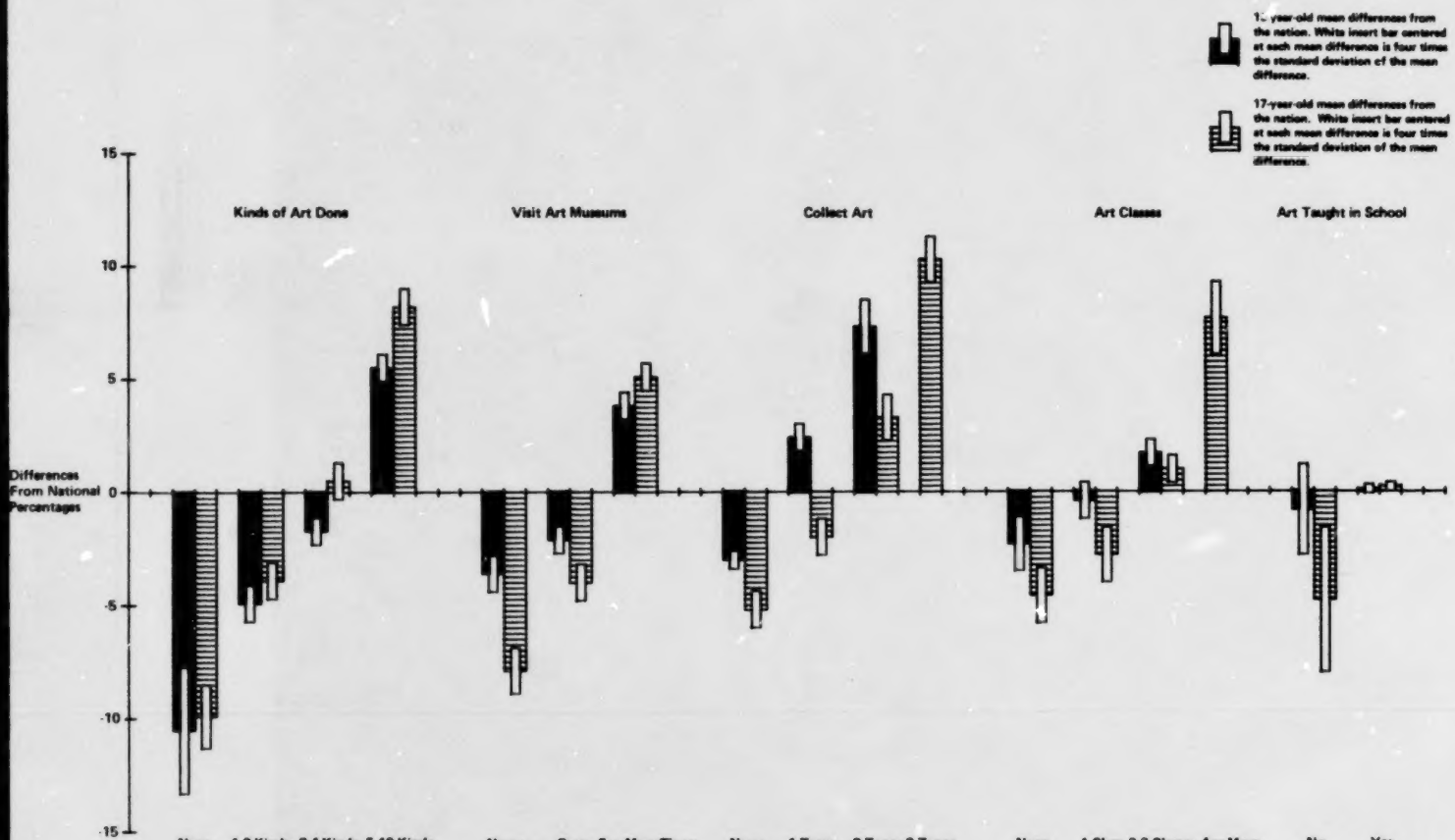
Singular Value Decomposition.

EXHIBIT 1. Average Differences From National Percentages of Correct Responses to Knowledge Exercises for Various Art Experience Categories: 13- and 17-Year-Olds in School


13-year-old mean differences from the nation. White insert bar centered at each mean difference is four times the standard deviation of the mean difference.
17-year-old mean differences from the nation. White insert bar centered at each mean difference is four times the standard deviation of the mean difference.
Kinds of Art Done
Visit Art Museums
Collect Art
Art Classes
Art Taught in School
15
10
5
0
-5
-15
Differences From National Percentages

	Kinds of Art Done				Visit Art Museums			Collect Art				Art Classes				Art Taught in School	
	None	1-2 Kinds	3-4 Kinds	5-10 Kinds	Never	Once	5 or More Times	None	1 Type	2 Types	3 Types	None	1 Class	2-3 Classes	4 or More	No	Yes
Difference From Nation	-6.2	-1.0	-0.2	2.0	-2.1	-0.8	1.9	-1.1	0.7	2.9		-1.3	0.1	0.6		0.2	-3.2
	-4.9	-1.8	0.3	3.8	-5.3	-3.2	3.7	-2.9	-0.6	2.1	4.5	-3.4	-1.7	0.8	5.0	0.2	-3.9
Standard Error	1.0	0.4	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.4		0.4	0.3	0.3		0.1	0.8
	0.6	0.3	0.4	0.4	0.4	0.4	0.2	0.3	0.3	0.5	0.5	0.5	0.5	0.3	0.8	0.1	1.4

EXHIBIT 2. Average Differences From National Percentages of Positive Responses to Affective Exercises for Various Art Experience Categories: 13- and 17-Year-Olds in School


13-year-old mean differences from the nation. White insert bar centered at each mean difference is four times the standard deviation of the mean difference.
17-year-old mean differences from the nation. White insert bar centered at each mean difference is four times the standard deviation of the mean difference.
Kinds of Art Done
Visit Art Museums
Collect Art
Art Classes
Art Taught in School
15
10
5
0
-5
-10
-15
Differences From National Percentages

	Kinds of Art Done				Visit Art Museums			Collect Art				Art Classes				Art Taught in School	
	None	1-2 Kinds	3-4 Kinds	5-10 Kinds	Never	Once	5 or More Times	None	1 Type	2 Types	3 Types	None	1 Class	2-3 Classes	4 or More	No	Yes
Difference From Nation	-10.5	-4.9	-1.7	5.5	-3.6	-2.1	3.8	-3.0	2.4	7.3		-2.3	-0.4	1.7		0.1	-0.8
	-9.9	-3.9	0.5	8.2	-7.9	-4.0	5.1	-5.2	-2.0	3.3	10.3	-4.6	-2.8	1.0	7.7	0.2	-4.8
Standard Error	1.4	0.4	0.3	0.3	0.4	0.3	0.3	0.2	0.3	0.6		0.6	0.4	0.3		0.1	1.0
	0.7	0.4	0.4	0.4	0.5	0.4	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.3	0.8	0.1	1.6

average difference from the national level of performance is similar for both 13- and 17-year-olds who have taken 2 or 3 art classes.

More exaggerated positive relationships between art experience and affective exercise performance are apparent in Exhibit 2. Greater percentages of positive responses emerge as the amount of each kind of experience increases. Seventeen-year-olds responded to two questions not asked of 13-year-olds concerning antique collecting and taking art classes in school from grade 7 through their present grade. Performance on affective exercises for 17-year-olds who collect antiques as well as art originals and reproductions and for those who have taken four or more art classes is much higher than the nation.

Performance patterns between ages across experiences are alike for both knowledge and affective exercise sets. The gap in performance between experience categories with the lowest and highest percentages of correct, or desirable, responses is larger for 17-year-olds than for 13-year-olds on all kinds of art experiences except doing art outside of school. In each case, the experience category with the lowest percentage of correct responses relative to the nation is also the category defined as having the least amount of the given experience, and the category with the highest difference percentage is similarly defined as having the maximum amount of the experience. This suggests that effects of art experiences on art achievement may be cumulative with age.

These patterns have stimulated the further exploration of relationships between art experiences and achievement presented in this article. The analysis technique used is Singular Value Decomposition (SVD), a principal-component analysis procedure that allows a large set of correlated art experience groups to be reduced to a smaller number of uncorrelated hypothetical components. The SVD procedure, rather than more common principal-component procedures, was selected because it is computationally efficient and it provides information about performance not readily obtainable from the usual factorizations.

Applying SVD to the art data for 13-year-olds and 17-year-olds who were enrolled in school at the time of the assessment, we wished to see if different art experience components related to art knowledge and positive attitudes toward art. The analysis should contribute to a simplified model of the role of art experiences in art knowledge and attitudes.

METHOD

Singular Value Decomposition is a data reduction procedure designed to determine whether uncorrelated experience components can be found to economically describe the relationship between knowledge, attitudes and experiences. It starts with a data matrix A that has m rows and n columns, where the rows are individual art knowledge and attitude exercises (87 for age 13 and 100 for age 17), and the columns are art experience categories found in the third column of Table 1. The elements, or cells, of matrix A are measures of the performance of respondents in a particular art experience category (column) on a specific art exercise (row).

Performance measures used for the art experience SVD analysis are the differences between the percentage of students in a particular experience category who respond correctly to an exercise and the percentage of students in the nation who responded correctly to the same exercise. These percentages are called Δp-values. They were selected as performance measures because they are minimally affected by exercise difficulty levels.

The Δp-values were adjusted to simplify interpretation. Each column was centered about its mean and then scaled to unit variance. This procedure assured equal weighting of the experience categories in the decomposition.

Singular Value Decomposition relies on a basic theorum in matrix algebra that states that any rectangular matrix A with m rows and n columns (where $m > n$) can always be expressed as the product of three matrices:

$$A = U \Sigma V$$

where U is an m x n matrix satisfying $U'U = I_n$, V is an n x n matrix satisfying $V'V = VV' = I_n$, and Σ is an n x n diagonal matrix. The diagonal matrix Σ contains nonnegative elements, $s_1, s_2, \ldots, s_n$, which are the singular values of matrix A and are arranged in descending order of magnitude from upper left to lower right.[1]

Principal components of the columns of matrix A -- art experience categories -- are uncorrelated linear combinations of the columns of A where the variance of each principal component, in turn, is maximal. The principal

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[1]P. Horst, Matrix Algebra for Social Scientists (New York: Holt, Rinehart and Winston, 1963) and P. Horst, Factor Analysis of Data Matrices (New York: Holt, Rinehart and Winston, 1965).

components of these exercise vectors are the products of the columns of U and the corresponding singular values. The elements of columns of V are the coefficients used to form the linear combinations of the columns of A, which are the principal components. That is, $AV = U\Sigma$.

Comparing the relative sizes of the elements of columns of U and V and the corresponding singular values is helpful in interpreting the results of Singular Value Decomposition. The relative positive or negative magnitudes of the elements $v_{k1}, \ldots, v_{kn}$ of v_k, the kth column of V, indicates the relative importance of each corresponding column of A in the linear combination that forms the kth principal component $s_k u_k$, where u_k is the kth column of U. These elements of v_k are directly proportional to the correlation between the kth principal component and the corresponding column of A. Thus, the largest positive element of v_{kj} indicates that the kth principal component is most like the meaning of the jth experience column of A. In fact, the correlation between the kth principal component and the jth column of A is $\frac{s_k v_{kj}}{\sqrt{m}}$. Conversely, a large negative element of v_k indicates that the meaning of the kth principal component is opposite to the meaning of the corresponding experience column of A.

Relative sizes and signs of the elements of the kth column of V determine the meaning of the kth principal component. This information can be used as a basis for judgment in assigning an experience label to the kth principal component, depending on which kinds of experiences are most highly correlated. A simplified hypothetical model with labels for the most important components of art experience can be said to be obtained if there are only a few uncorrelated components that account for most of the variance in art knowledge and attitude Δp-values or total column variance.

The total column variance in A is equal to n, the number of columns of A, since each column of A was centered and scaled to unit variance. Since it can be shown that the variance among the elements of the kth principal component is s_k^2/m, it follows that the sum of s_k^2/m over all principal components is also n. The proportion of total column variance accounted for by the kth principal component can then be defined as s_k^2/nm, and the amount of variance accounted for by any set of uncorrelated principal components in a hypothetical model can be determined.

If a parsimonious set of principal components has been obtained with the methods described, the columns of U can be used to examine how specific art exercises (rows of A) are related to the meaning of the experience factor labels for columns of U. For example, if a meaningful set of principal components has been identified, the elements of the kth principal component (or equivalently, elements of the kth column of U) can be sorted from large positive through large negative values. Exercises found at the extremes of this

continuum are those with the strongest relationships to the meaning of the kth component. Since principal components are uncorrelated, the process of identifying exercises important to the meaning of each remaining component can proceed component by component.

The goal of SVD analysis then, is to identify a few, meaningful and uncorrelated principal components of art experience that account for most of the variability in performance on art knowledge and attitudes, and which can also be used to identify exercises most closely related to each component. An efficient algorithm for the decomposition of nonsquare matrices proposed by Golub and Reinsch[2] was applied to data from 87 exercises for 13-year-olds and 100 exercises for 17-year-olds to accomplish the art experience SVD analysis.

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[2]G.H. Golub and C. Reinsch, "Singular Value Decomposition and Least Squares Solutions," American Mathematician, 14 (1970), pp. 403-20.

RESULTS

Sets of coefficients of the experience categories, columns of V, for the first three principal components are presented in Table 2. The elements of $\underset{\sim}{v}_1$, $\underset{\sim}{v}_2$ and $\underset{\sim}{v}_3$ are shown along with the corresponding singular values s_1, s_2 and s_3 and the amount of variance accounted for by each component. Taken together, the first three components account for 89% of the total variance in art performance for 13-year-olds and nearly 91% of the total variance for in-school 17-year-olds.

An indication of the meaning of each principal component can be obtained from Table 2. All five kinds of experiences shown in Table 2 are positively associated with the first component. The strength of each relationship varies roughly with the amount of active student participation implied by each experience. Thus, doing art, visiting art museums and collecting art all require active participation and contribute substantially to the meaning of the component. Taking art classes is an elective activity at age 17 and often a forced choice at age 13, so we see art classes taken as a very influential 17-year-old component and somewhat less influential at age 13 where students may be less inclined to participate in an activity they did not initiate. Since the existence of art classes in a student's school does not necessarily imply student participation, "Art taught in school" makes the smallest contribution to the first component.

It follows that the first principal component can be interpreted as a general measure of student participation in artistic activities. Considering the relative importance of elective art classes at age 17 and nonelective ones at 13, and the fact that students are unlikely to do art outside of school or to collect art if they do not wish to, the first component could also be interpreted as a measure of the effects of both participation and volition. It is clearly an important component, accounting for 53% of the total variance in 13-year-old performance and 60% of the total variance at age 17.

The second principal component accounts for an additional 25% of the variance in performance at age 13 and 21% at age 17. It is bipolar, comparing extracurricular with curricular experiences -- "Art classes taken" and "Art taught in school" compared with "Collect art" and "Kinds of art done" for 13-year-olds, and "Art taught in school" compared with "Collect art" and "Kinds of art done" for 17-year-olds. The performance of those who do art outside of school and who collect art is positively associated with the component. We can describe the component as measuring individual participation in artistic activities beyond the school's purview.

TABLE 2. SVD* Results for the First Three Experience Components at Ages 13 and 17 (in School): Group Coefficients, Singular Values and Percents of Variance Accounted for by Each Component

Experience Groups	Columns of V					
	13-Year-Olds			17-Year-Olds in School		
	V_1	V_2	V_3	V_1	V_2	V_3
Art classes taken						
0 or 1	-.224	.408	-.529	-.325	.038	-.584
2 or more	.232	-.412	.508	.328	-.058	.569
Art taught in school						
No	-.150	.503	.466	-.117	.637	.192
Yes	.158	-.492	-.481	.110	-.637	-.193
Kinds of art done						
Less than 5	-.384	-.210	.048	-.365	-.148	.132
5 or more	.384	.207	-.056	.371	.143	-.107
Visit art museums						
0 or 1 time	-.372	-.038	.007	-.361	.123	.036
5 or more times	.371	.052	-.004	.363	-.126	-.007
Collect art						
None	-.373	-.200	.072	-.336	-.239	.352
1 or more kinds	.372	.193	-.051	.339	.231	-.328
Singular value	21.550	14.668	9.795	24.576	14.490	9.791
Percent of variance accounted for	53.4	24.7	11.0	60.4	1.0	9.6
Cumulative percent of variance accounted for to given factor	53.4	78.1	89.1	60.4	81.4	91.0

Singular Value Decomposition.

Bipolarity is also apparent in the third component at both ages, comparing "Art classes taken" with "Art taught in school" for 13-year-olds, and "Art classes taken" with "Collect art" for 17-year-olds. In both cases, the component appears to be one of participation in scholastic art experiences, although it appears to be active as opposed to passive scholastic experiences at age 13, and active scholastic as opposed to extracurricular art experiences at age 17. It accounts for an additional 10% of the variance in performance for 13- and 17-year-olds.

Exercises were ordered by the corresponding elements of $\underset{\sim}{U}_1$, $\underset{\sim}{U}_2$ and $\underset{\sim}{U}_3$, from high to low.[1] Tables 3 and 4 show the 15 exercises and elements lying at each extreme of each continuum. Exercise numbers convey basic information about each exercise, those beginning with 2 refer to affective, or attitudinal, exercises and those beginning with 1, 4 and 5 are assigned to knowledge, or cognitive, exercises. Values for the exercises in Tables 3 and 4 can be compared within principal components. Comparisons of values between components must be made on the basis of the products of the elements of each column of U and the corresponding singular values.

The principal components can be interpreted in terms of exercise characteristics by examining Tables 3 and 4. If there is a strong association between the characteristics and the meaning of the components, exercises with common characteristics should collect at each end of each ordered vector. Considering the affective and cognitive characteristics of the art exercises, they seem to be strongly associated with the first principal component at each age. The top 15 exercises in the first component are nearly all affective; a majority of the bottom 15 are cognitive, although they are mixed with some affective exercises. Thus, we can say active participation in artistic activities is associated with positive attitudes toward art.

The exercise configurations differ for 13- and 17-year-olds on the second and third components. Table 3 shows clusters of affective and cognitive exercises that are very similar for all three principal components at age 13. The second 13-year-old component, individual participation in artistic activities, and the third, participation in scholastic art activities, are both related to 13-year-olds' positive attitudes toward art.

Exercises at the extremes of the components for 13-year-olds are shown in Table 4. No obvious clusters of affective or cognitive exercises appear in these lists for the second and third components. There seems to be no strong differentiation of 17-year-olds' participation in individual artistic activities or their participation in scholastic art activities with respect to affective and cognitive exercise characteristics.

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[1]A table showing the distribution of exercises by major objective and age can be found in the Appendix.

TABLE 3. 15 Exercises at the Extremes of the First Three Principal Components for 13-Year-Olds When the Elements of y_1, y_2 and y_3 Have Been Arranged in Descending Order

y_1*		y_2		y_3	
Exercise Number†	Elements	Exercise Number	Elements	Exercise Number	Elements
204009	0.300	203055	0.460	101034	0.227
205002	0.185	203009	0.285	203014	0.203
201021	0.181	201004	0.277	205009	0.197
201011	0.175	201001	0.246	203036	0.196
205011	0.166	204002	0.164	205001	0.160
204001	0.144	203017	0.153	201031	0.153
203010	0.141	203011	0.150	203021	0.153
205018	0.137	205002	0.137	204012	0.150
204007	0.135	101019	0.137	201022	0.148
201013	0.129	201031	0.131	203055	0.144
204015	0.120	404001	0.122	203012	0.144
204012	0.113	403090	0.109	401021	0.141
204024	0.106	205011	0.106	401001	0.131
204030	0.105	201019	0.105	205020	0.128
504008	0.105	403046	0.087	402011	0.125
401016	-0.097	205018	-0.098	204024	-0.104
205020	-0.102	204030	-0.098	403004	-0.105
403037	-0.104	204011	-0.098	101034	-0.109
401001	-0.107	204004	-0.101	204002	-0.119
403034	-0.109	403036	-0.112	102041	-0.124
201028	-0.112	401016	-0.112	101025	-0.128
203055	-0.125	203039	-0.119	203048	-0.130
401004	-0.127	204010	-0.131	403090	-0.134
404004	-0.135	102024	-0.132	403043	-0.151
101025	-0.143	401005	-0.139	402012	-0.153
203012	-0.183	203046	-0.151	401019	-0.171
401019	-0.184	101034	-0.164	101006	-0.183
101034	-0.253	101006	-0.165	503018	-0.210
501011	-0.263	204007	-0.168	402002	-0.215
201026	-0.286	503005	-0.172	201004	-0.235

*The principal component is $y_k s_k$, where s_k is the kth singular value; thus comparisons of the magnitudes of elements within y_k are the same as comparisons of $y_k s_k$ for the kth component. Comparisons between components cannot be made unless the $y_k s_k$ are used.

†Exercise numbers contain basic information about the exercises. Exercise numbers beginning with 2 are affective numbers and of these only the ones with a 3 as the third digit do not involve picture stimuli. Exercise numbers beginning with 1 or 4 are knowledge/cognitive in nature, and exercise numbers beginning with 5 refer to judgmental/cognitive content.

TABLE 4. 15 Exercises at the Extremes of the First Three Principal Components for In-School 17-Year-Olds When Elements of μ_1, μ_2 and μ_3 Have Been Arranged in Descending Order

μ_1*		μ_2		μ_3	
Exercise Number†	Elements	Exercise Number	Elements	Exercise Number	Elements
203011	0.263	203055	0.449	402012	0.225
201011	0.230	203009	0.266	204001	0.191
205011	0.186	201029	0.245	203050	0.184
201021	0.178	201011	0.178	503005	0.180
402011	0.177	403083	0.173	401016	0.172
201022	0.170	503043	0.157	401019	0.170
204005	0.142	503014	0.123	102041	0.169
205002	0.139	101019	0.115	405005	0.158
204001	0.138	201004	0.114	203039	0.129
203010	0.137	204030	0.099	503043	0.122
503005	0.123	403096	0.097	203046	0.117
204009	0.123	401005	0.089	503026	0.112
203014	0.102	204010	0.088	201028	0.111
205004	0.096	203011	0.086	204024	0.103
201004	0.095	403036	0.080	102061	0.102
203021	-0.099	205009	-0.099	203021	-0.104
201026	-0.099	101041	-0.101	203009	-0.105
403096	-0.110	204021	-0.102	201031	-0.116
404004	-0.113	203050	-0.110	403068	-0.123
501011	-0.124	101034	-0.112	401021	-0.126
102016	-0.143	203010	-0.114	102032	-0.133
101025	-0.170	204007	-0.117	504008	-0.154
405014	-0.171	204012	-0.125	101034	-0.155
401016	-0.179	503005	-0.129	205012	-0.164
403068	-0.181	203046	-0.138	101034	-0.174
402027	-0.182	403046	-0.153	403046	-0.179
403083	-0.182	203036	-0.163	201021	-0.198
203012	-0.185	405005	-0.181	201011	-0.203
501011	-0.199	204005	-0.194	101034	-0.230
101034	-0.276	101034	-0.255	201016	-0.266

*The principal component is $\mu_k s_k$, where s_k is the kth singular value; thus comparisons of the magnitudes of elements within μ_k are the same as comparisons of $\mu_k s_k$ for the kth component. Comparisons between components cannot be made unless the $\mu_k s_k$ are used.

†Exercise numbers contain basic information about exercises. Exercise numbers beginning with 2 are affective exercises and of these only the ones with a 3 as the third digit do not involve picture stimuli. Exercise numbers beginning with 1 or 4 are knowledge/cognitive in nature, and exercise numbers beginning with 5 refer to judgmental/cognitive content.

CONCLUSION

Variations across exercises in the percentages of 13- and 17-year-olds who gave correct (desirable) answers to art exercises can be 89% to 91% accounted for by three components of art experiences. The first is a general participation in artistic activities, whether scholastic or extracurricular, the second is individual participation and the third is scholastic participation. The third component is interpreted somewhat differently for the two age groups: it is active instead of passive scholastic experiences at age 13, and active scholastic instead of extracurricular experiences at age 17. Further, the first experience component at both ages is strongly associated with positive attitudes toward art as are the second and third components at age 13.

To this extent the Singular Value Decomposition of art experiences has been successful. We have identified a reduced set of three uncorrelated principal components that account for most of the variations in performance across exercises, and we have identified the exercise characteristics that are most closely associated with the components for age 13.

APPENDIX

NUMBERS OF ART EXERCISES BY ART OBJECTIVES AT AGE 13 AND 17

	13-Year-Olds	17-Year-Olds
Objective I	11	13
Objective II	51	51
Objective IV	18	28
Objective V	7	8
Subtotals:		
Affective (II)	51	51
Cognitive (I, IV, V)	36	49
TOTAL EXERCISES	87	100